L. San Francisco Bay Area Air Basin (Bay Area AQMD)

The San Francisco Bay Area Air Basin is comprised of a single district, the Bay Area AQMD, and consists of Napa, Marin, San Francisco, Contra Costa, Alameda, San Mateo, and Santa Clara counties, the southern portion of Sonoma County, and the western portion of Solano County. The air basin currently exceeds both the 24-hour and the annual State PM10 standards, as well as the State annual PM2.5 standard.

Figure L-1 shows the location of the PM10 (a) and PM2.5 (b) monitoring sites throughout the San Francisco Bay Area Air Basin.

Figure L-1. PM10 and PM2.5 Monitoring Sites throughout the Air Basin.

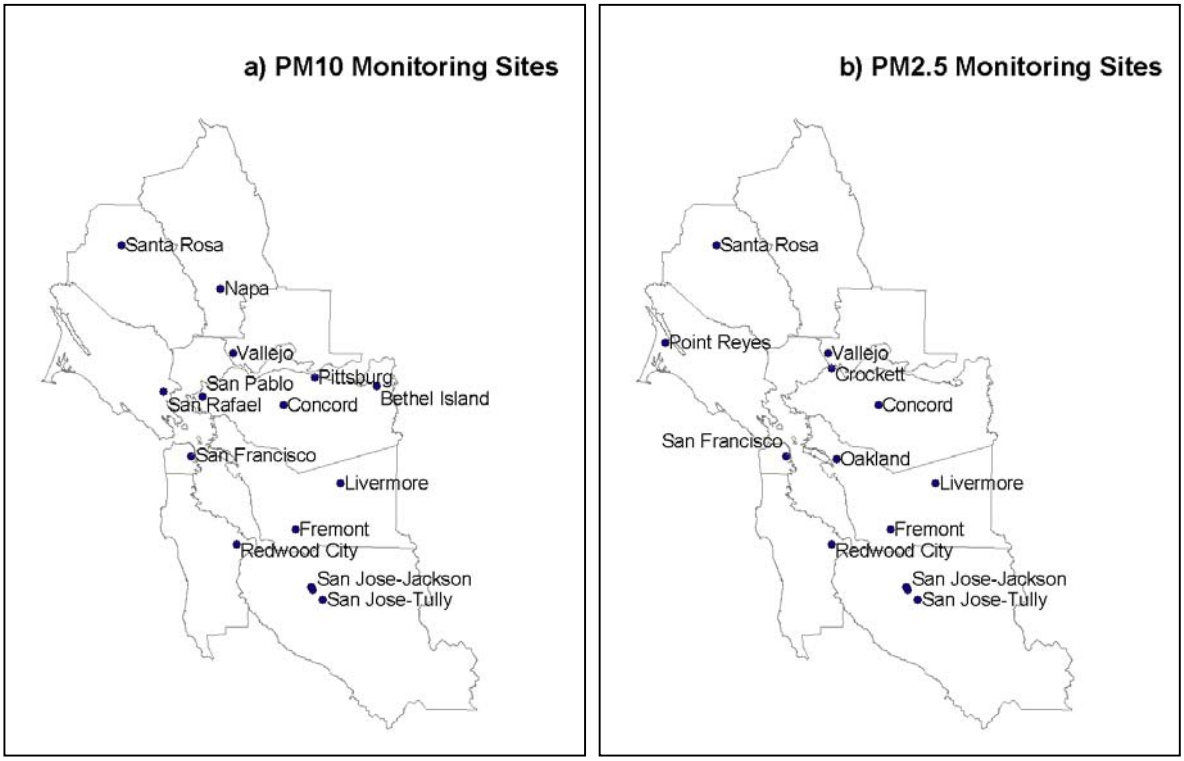


Table L-1 provides information on yearly variations in the highest PM10 and PM2.5 concentrations recorded across the Bay Area AQMD in 2001 through 2003. We estimate that during this period, particulate levels exceeded the State 24-hour PM10 standard of 50 $\mu g/m^3$ ninety times. PM10 levels also exceeded the State annual standard of 20 $\mu g/m^3$. PM2.5 levels exceeded the State annual PM2.5 standard of 12 $\mu g/m^3$ in 2001 and 2002.

Table L-1. PM10 and PM2.5 Air Quality in the Bay Area AQMD.

Year	PM10 (ug/m^3)			PM2.5 (ug/m^3)	
	Calculated Days over State Std.	Max 24-hour (Std.=50)	Max Annual Average (Std.=20)	Max 24-hour*	Max Annual Average (Std.=12)
2001	48	114**	30	108	13
2002	24	84	26	85	14
2003	18	59	25	56	12

* The maximum 24-hour PM2.5 values are provided for information only.
** This value was excluded for determining attainment status. See text.

Table L-2 provides the 24-hour and annual designation values for the State standards for the 2001-2003 period. Designation values represent the highest 24-hour PM10 concentration measured during the three year period, after concentrations measured during highly irregular and infrequent events have been excluded, and the highest estimated PM10 and PM2.5 annual average in the same period. For example, the high 24-hour PM10 concentration in 2001 shown in Table L-1 was identified as an extreme concentration event and was excluded in determining the designation values shown in Table L-2. The designation values are determined for each site, and the highest site is used for determining an area's designation. Based on these data, the Bay Area AQMD currently is nonattainment for both the State 24-hour and annual average PM10 standards, as well as the State annual average PM2.5 standard.

Table L-2. Air District Level Designation Values* for the State PM10 and PM2.5 Standards (2001-2003 Period).

	PM10 (ug/m^3)		PM2.5 (ug/m^3)
	24-Hour (Std.=50)	Annual Average (Std.=20)	Annual Average (Std.=12)
Designation Value	87	25	14

* Designation value is the value used for determining attainment status. It is the highest measured value over three years after excluding highly irregular or infrequent events.

Table L-3 provides designation values for each monitoring site in the air district to provide further information on the geographic distribution of concentrations. Particulate levels exceeded the State 24-hour standard at all fourteen PM10 monitoring stations in the air district, with highest concentrations at Livermore, Concord, Pittsburgh, and San Jose-Tully. Five sites, San Pablo, Napa, San Francisco, San Jose-Jackson, and San Jose-Tully exceeded the State annual PM10 standard. PM2.5 levels over the annual standard occurred at three of the eleven monitoring sites (Livermore, San Francisco, and Vallejo).

Table L-3. Monitoring Site Level Designation Values* for the State PM10 and PM2.5 Standards (2001-2003 Period).

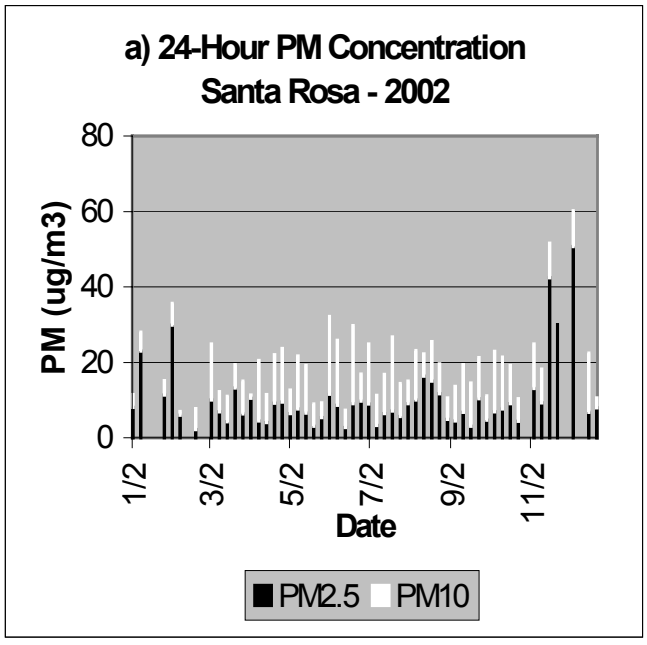
Site	PM10 (ug/m^3)		PM2.5 (ug/m^3)
	24-Hour (Std.=50)	Annual Average (Std.=20)	Annual Average (Std.=12)
Fremont	60	18	Incomplete Data
Livermore	87	19	14
Oakland	No Monitor	No Monitor	Incomplete Data
Bethel Island	79	19	No Monitor
Concord	87	22	10
Crockett	No Monitor	No Monitor	Incomplete Data
Pittsburgh	83	Incomplete Data	No Monitor
San Pablo	70	21	No Monitor
Point Reyes	No Monitor	No Monitor	Incomplete Data
San Rafael	73	18	No Monitor
Napa	70	21	No Monitor
San Francisco	79	23	13
Redwood City	68	20	11
San Jose-Jackson	73	24	12
San Jose-Tully	86	25	12
Vallejo	61	17	14
Santa Rosa	68	17	11

* Designation value is the value used for determining attainment status. It is the highest measured value over three years after excluding highly irregular or infrequent events.

Figure L-2 illustrates the variation in PM10 and PM2.5 levels throughout 2002 at Santa Rosa (a); San Jose Tully (b); San Francisco (c); and Livermore (d). The total height of the bars represents PM10 concentrations, while the height of the black portion of the bars represents the PM2.5 fraction. Throughout the air district, PM10 concentrations were highest during the winter (mostly November and December), with the highest PM2.5 fractions throughout the winter. The colder, more stagnant conditions during this time of the year are conducive to the buildup of PM, including the formation of secondary ammonium nitrate. In addition, increased activity from residential wood combustion may also occur. Wildfires in 2002 may also have contributed to peaks in PM2.5 concentrations at San Jose, San Francisco, and Livermore in August.

Higher levels of the coarse fraction (particles between PM2.5 and PM10 in size) occurred throughout the rest of the year. The coarse fraction is primarily due to activities that resuspend dust, such as emissions from paved and unpaved roads and construction. In some coastal sites, sea salt can also contribute to the coarse fraction. Based on 2000-2003 monitoring data, we estimate that the PM2.5 fraction accounts for approximately 60 percent of PM10 during the winter and approximately 45 percent during the rest of the year. On an annual basis, we estimate that PM2.5 comprises approximately 50 percent of the PM10 levels.

Figure L-2 (a and b). Seasonal Variation in PM10 and PM2.5 Concentrations.



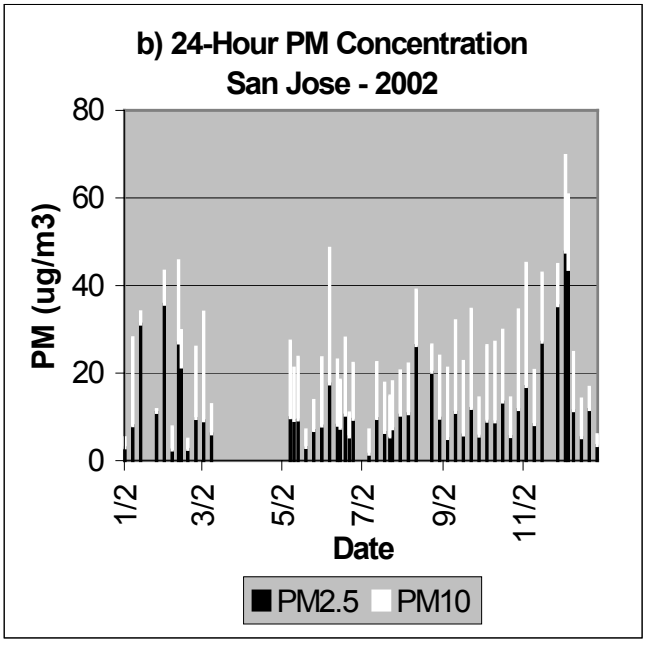
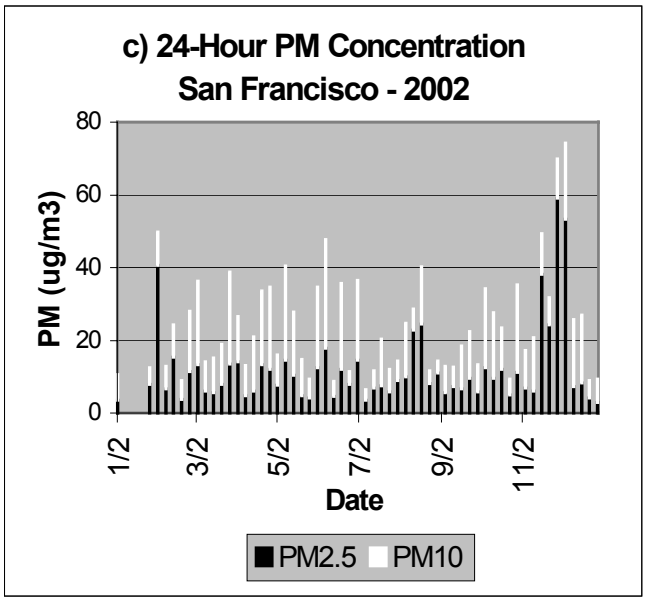


Figure L-2 (c and d). Seasonal Variation in PM10 and PM2.5 Concentrations.



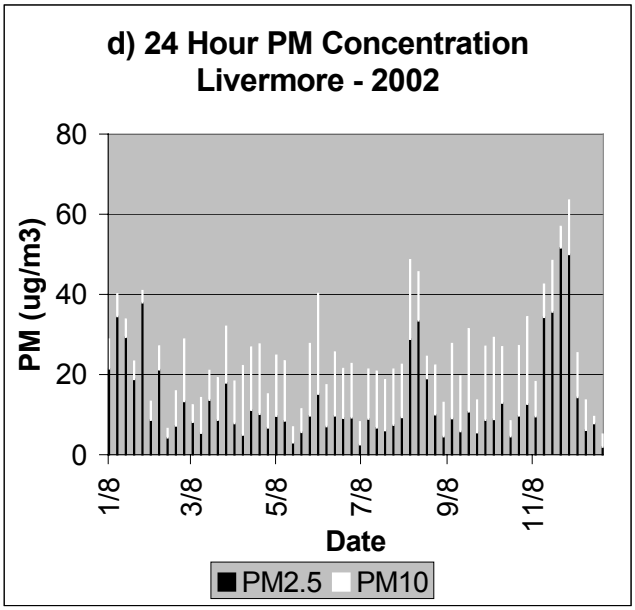


Figure L-3 presents the average hourly variation in PM2.5 levels for days within the year with the highest PM2.5 concentrations at Vallejo (a); Oakland (b); San Francisco (c); Livermore Rincon Avenue (d); and San Jose (e). At most sites, PM2.5 concentrations remain elevated throughout most of the day and night. In contrast, at Vallejo a distinct diurnal pattern of PM2.5 levels occurred with the highest concentrations occurring from 1 to 4 a.m. Peak evening concentrations generally reflect the influence of lowering inversion heights which trap pollutants close to the surface, as well as increased activity from evening commute traffic and residential wood combustion during winter months. Elevated concentrations during the day can often reflect the influence of secondary ammonium sulfate and ammonium nitrate formation through reaction in the atmosphere of NOx and SOx emitted from mobile and stationary combustion sources.

Figure L-3. Hourly Variation in PM2.5 Concentrations.

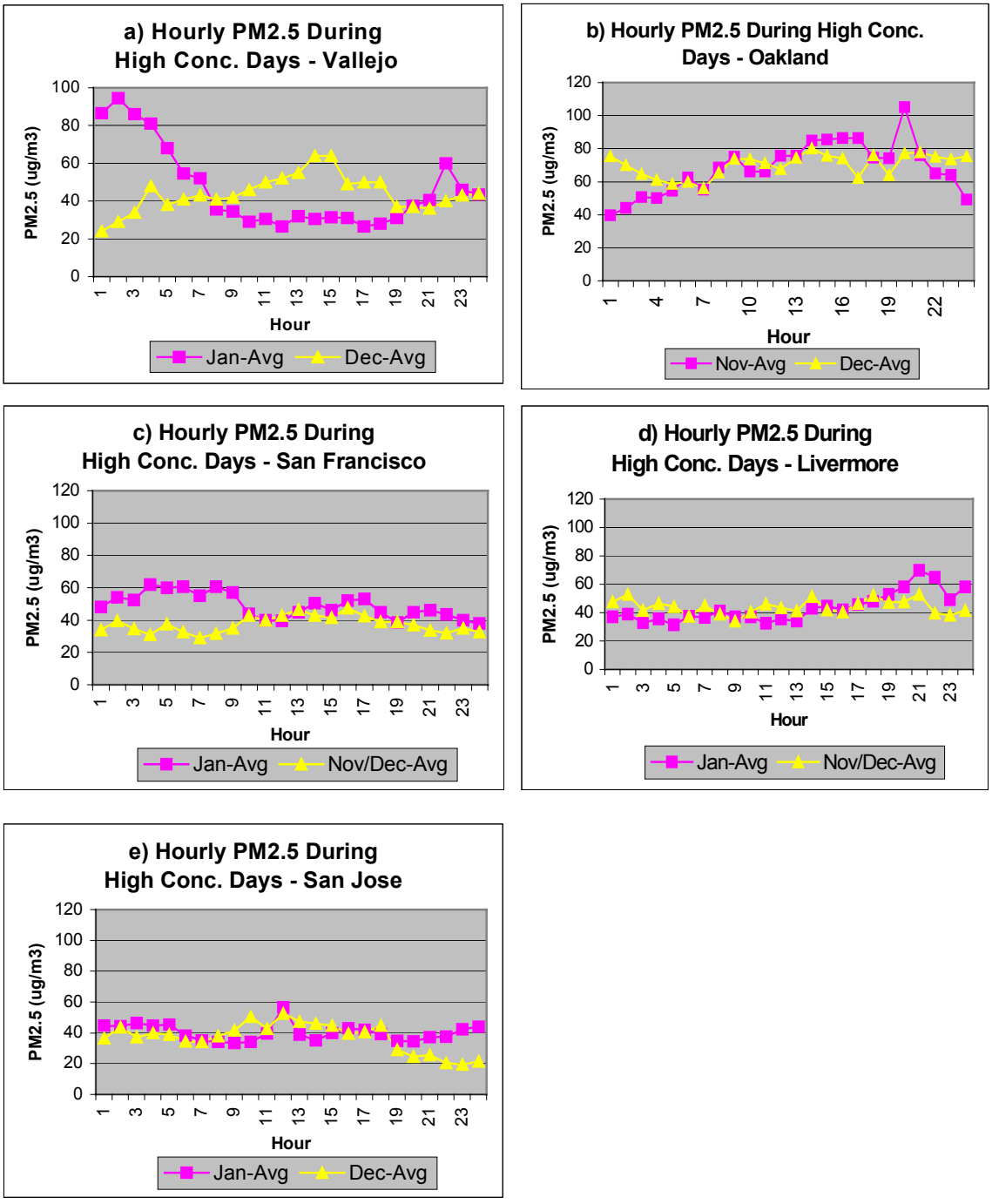
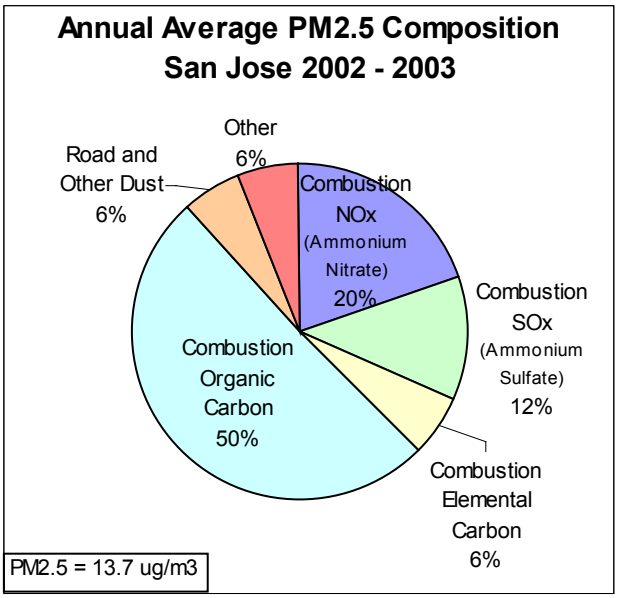


Figure L-4. Chemical Composition of Annual Average PM2.5 and Link to Emission Source Type.

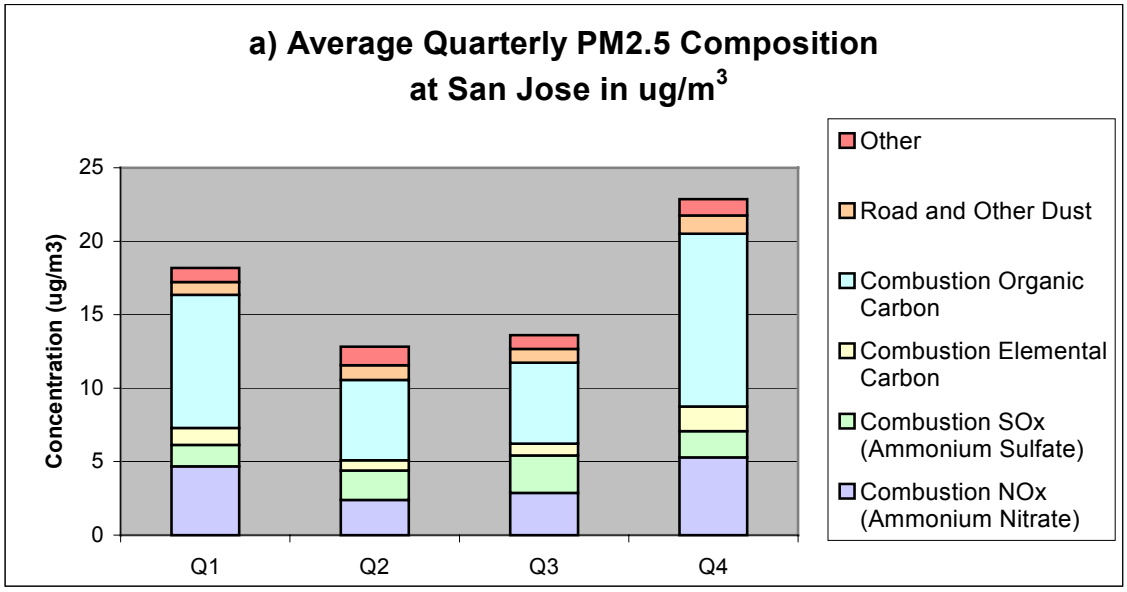


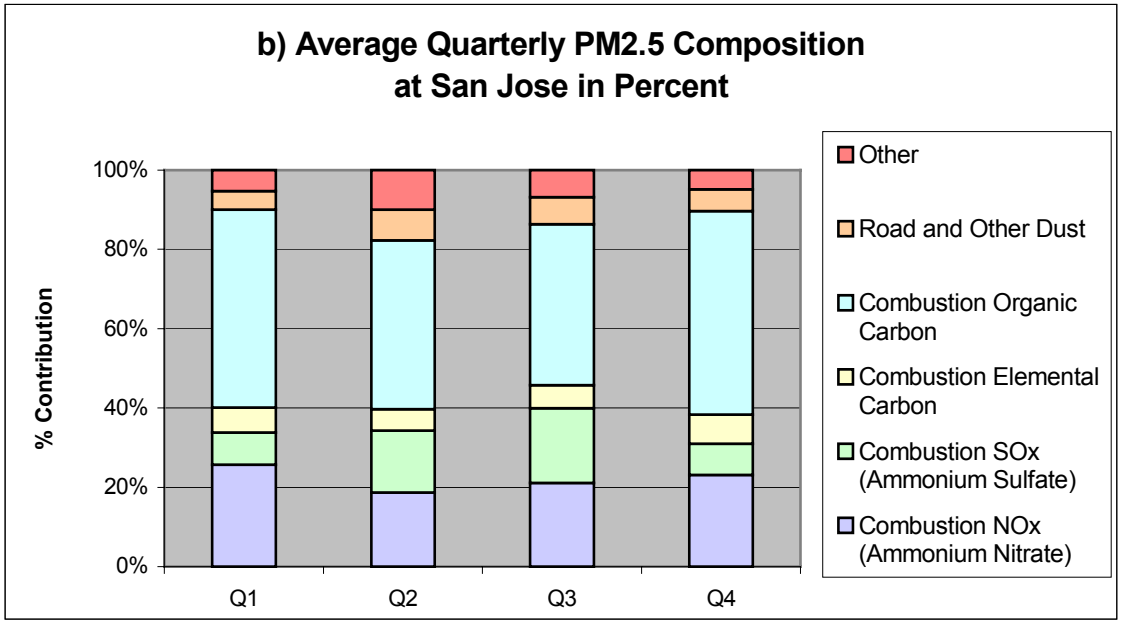
Data for Figure L-4 are from analysis of ambient PM2.5 data collected at San Jose Jackson from the State's PM2.5 speciation network. Chemical components have been associated with possible emission sources based on emission inventory information. On an annual average basis organic carbon is the major component of PM2.5 (50 percent). The majority of organic carbon is suspected to be due to directly emitted carbon from combustion sources. Key sources include vehicles, residential wood combustion, agricultural and prescribed burning, and other stationary combustion sources. However, a fraction may be due to secondary organic aerosol formation from anthropogenic and biogenic VOC emissions.

Ammonium nitrate and ammonium sulfate - formed in the atmosphere from chemical reactions of NOx and SOx from mobile and stationary source combustion processes - also contribute significantly to ambient PM2.5 (32 percent), with ammonium nitrate contributing twice as much as ammonium sulfate. Dust from roads and other dust producing activities, and elemental carbon from combustion processes contribute to a lesser extent.

Figure L-5 illustrates the quarterly variation in PM2.5 levels and its chemical components expressed in $\mu g/m^3$ (a) and as percent of PM2.5 (b) at San Jose. As in the previous figures, chemical components have been associated with possible emission sources based on emission inventory information. The higher PM2.5 concentrations in the October-December period were primarily caused by an increase in the organic carbon component along with a smaller increase in ammonium nitrate.

Figure L-5. Chemical Composition of Average Quarterly PM2.5 and Link to Emission Source Type.

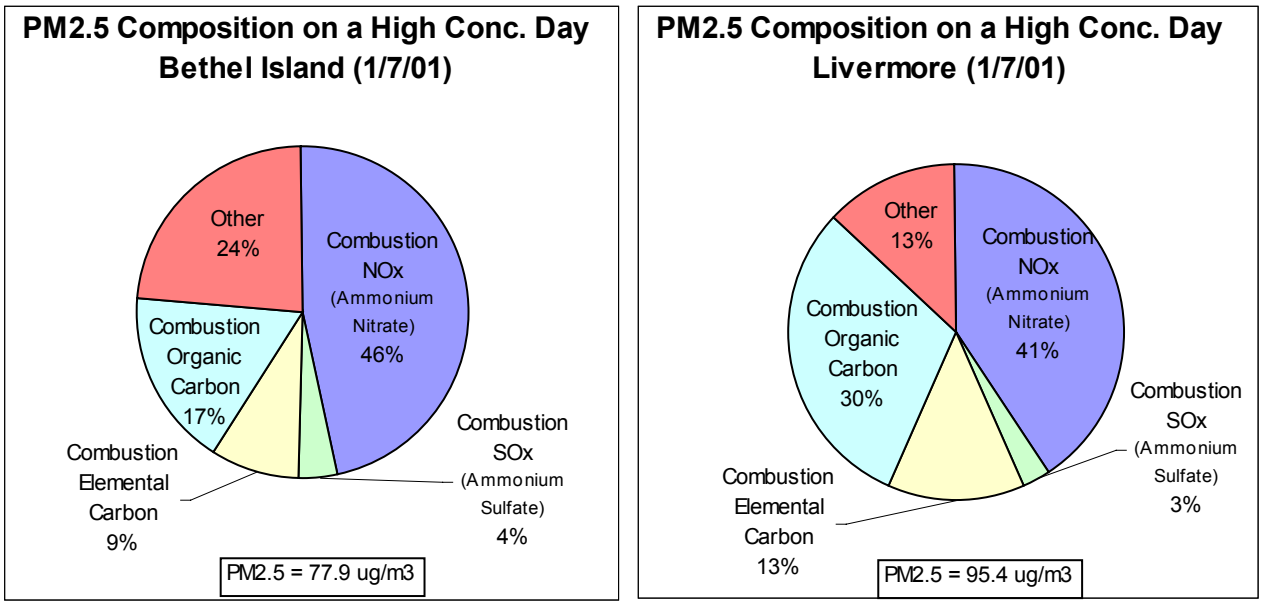




Data for Figure L-6 are from PM2.5 data collected as part of the 2000 California Regional PM10 and PM2.5 Air Quality Study. Chemical components have been associated with possible emission sources based on emission inventory information. Figure L-6 presents the chemical composition of PM2.5 and associated emission sources on a January 2001 day when PM2.5 levels exceeded 50 $\mu g/m^3$ at Bethel Island (a) and Livermore (b). On this day ammonium nitrate was the major contributor to ambient PM2.5 concentrations. The organic and elemental carbon fractions at Livermore were significantly higher than at Bethel Island, reflecting the difference in the level of combustion source activity.

Figure L-6. Chemical Composition of PM2.5 on a High Concentration Day.

a) Bethel Island **b) Livermore**



Figures L-7 and L-8 present the results of a chemical mass balance modeling performed using ambient PM data collected at San Jose - PM10 data from August 1993 through January 1994 (a) and PM2.5 data from December 2000 through January 2001 (b) (Fairly 2001). The chemical mass balance modeling provides further resolution on the sources of organic and elemental carbon. During the winter, residential wood smoke and cooking are the major contributors to the observed carbon and to ambient PM overall. Combustion PM2.5, which includes vehicle exhaust is the second major component of PM2.5 and a significant component of PM10. Ammonium nitrate formed from reactions in the atmosphere of NOx from motor vehicles and other combustion sources is also a principal component of ambient PM. Winter conditions – cool temperatures, low wind speeds, low inversion layers, and high humidity – favor the formation of ammonium nitrate. Road dust and other dust producing activities are another major contributor to ambient PM10, but not to the PM2.5 fraction.

Figure L7. Source Apportionment of Winter PM10 Using Chemical Mass Balance.

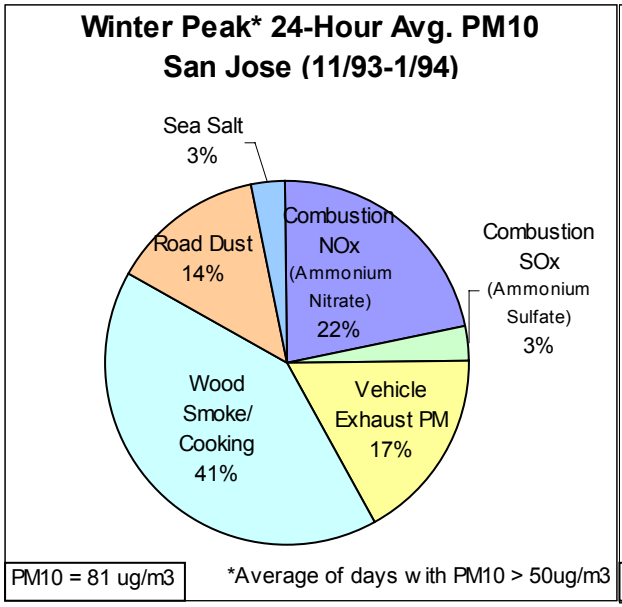


Figure L8. Source Apportionment of Winter PM2.5 Using Chemical Mass Balance.